STANDARD 1 – WATERSHED HEALTH

> *Within the potential of the ecological site (soil type, landform, climate, and geology), soils are stable and allow for water infiltration to provide for optimal plant growth and minimal surface runoff.*

The analysis area contains all the Great Divide Basin and portions of the North Platte River Basin within the RFO boundary(Maps #4 & #5). Table #2 depicts the 4th Order HUCs, acreages, and groupings of these watersheds that will be discussed for Standard 1.

Table # 2 –Sub-Area Acreage Included in the Analysis Area

Sub-Area (report sections)	Acreage	4th Level HUCs*
Great Divide Basin (without Upper/Lower Separation Creek/Boggy Meadows)	1,032,272	14040200 - Great Divide Closed Basin
Upper/Lower Separation Creek/Boggy Meadows (portion of Great Divide Basin)	619,352	
Sweetwater River (RFO)	144,946	1018006 - Sweetwater
North Platte River Basin other than Sweetwater River	246,105	10180002 – Upper North Platte 10180003 – Pathfinder – Seminoe Reservoir
Total	2,042,675	

***** HUCs – United States Geological Survey Hydrologic Unit Codes.

Great Divide Basin (without Upper/Lower Separation Creek, Boggy Meadows)

1) Characterization:

This discussion includes the following fifth order watersheds: Battle Springs Flat, Buck Draw, Cyclone Draw, Latham Draw, Lost Creek, Red Creek, Red Desert Basin, Red Wash Draw, and Salt Sage Draw. These watersheds are all very similar in terms of an arid (< 10 inches of rain annually) environment, predominantly shale and sandy clay-loam soils, and ephemeral drainages. Rapid snowmelt or thunderstorms can produce moderate to high runoff with medium to high erosion potential. Topography is flat to gently rolling landscape for the most part, becoming moderately steep to steep close to rims (picture 10-1). The range in elevation is only 900 feet between the highest and lowest points in the watershed, so gradient changes within drainages are low. Wind redeposits snow on the leeward side of vegetation and topographic features, typically the north and east sides. This can alter vegetation and soils, as well as runoff occurrence and duration (picture 10-2). At the terminus of creek systems are playas or water sources such as Hay Reservoir for Red Creek and Lost Creek Lake for Lost Creek. In wet years these lakes will last from one season to the next, but they will dry up during years with normal to below normal precipitation. The rest of the water sources have been developed around wells or on natural

springs. These areas can be important for livestock and wildlife and may support wetland vegetation as discussed in Standard 2. Groundwater resources are critical for these areas and will be discussed in Standard 5.

Due to low topographic relief and infrequent flow events, channel formation is generally weak on smaller drainages and more pronounced on a few larger stream systems. Both types have wide floodplains. However, smaller drainages have channels that range from a few feet across by one to two feet deep to just slight depressions that are hardly recognizable. Larger systems like Lost Creek have very defined channels that are wide and shallow. Erosion sources include both uplands and in-channel. Peak flows usually occur in February through April when temperatures rise and snow melts across the whole watershed in a short period of time. Flows are erratic and short-term, with no recording of perennial flows.

The only sites where channel classification was determined, was along portions of Lost Creek, which is a D5 stream type. The D5 stream type is described as a braided stream, found within broad alluvial valleys, with predominantly sand channel bed material, interspersed with silts and clays (picture 11-1). The braided system consists of interconnected distribution channels formed in depositional environments. Channel gradients are generally less than 2% with very high width/depth ratios of 40 to 50 up to 400 or larger. The braided channel system is characterized by high bank erosion rates, excessive deposition occurring as both longitudinal and transverse bars, and annual shifts of the bed location (Rosgen 1996).

Principal human uses in this watershed are natural gas development, livestock grazing, and recreation. Natural gas development has occurred in the area for many years. However, it has expanded in scope of area as well as in-field drilling over the last 10 years (picture 11-2). Around Wamsutter, well density is reaching an 80-acre spacing, whereas in most areas 160-acre spacing is more common. Livestock use is primarily cattle, both cow/calf and yearling operations. Sheep use also still occurs on a few allotments. Seasons of use for livestock vary by allotment. Winter use is somewhat dependent on annual climate conditions. Recreation is largely related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

Water and wind erosion, as well as gully formation, are important indicators of watershed health, which are influenced by vegetation health and groundcover. Erosion can result in the loss of topsoil and reductions in site productivity in the uplands and horizontal adjustments of stream channels. Management factors that affect these processes are described below.

1. Livestock Grazing: Livestock grazing has been and continues to be the principal factor affecting watershed values in terms of vegetative cover and litter (picture 11-3). Since channels and flow regimes are ephemeral, the focus is primarily on uplands. Management issues relate to the season, duration, and distribution of use rather than stocking rates. The key question is in what locations do further refinements in BMPs or other actions still need to be made to improve watershed health and meet desired resource conditions?

2. Erosion: Erosion from roads, both improved and unimproved, is the second most important factor relating to watershed health. The BLM, Sweetwater County, and various oil and gas companies all maintain improved roads within the watershed. The principal problem with improved roads is inadequate water control features, such as culverts, wing-ditches, and water-bars, to mitigate the effects of roads on upland runoff hydrology. Road standards are based on how to build and maintain a safe road, rather than what effect the road has on altering the natural

hydrology of the landscape. As a result, roads tend to collect water off a broad area and then release it in a more concentrated volume, in a draw or flared onto a hillside undeveloped for this flow, causing accelerated erosion. Since the Great Divide Basin has no external outlets, this erosion is localized and is not necessarily affecting values outside this watershed (except by wind erosion). For each mile of improved road there are probably ten miles of unimproved roads or two-tracks. Many of these two-tracks do not cause increased erosion, but where it does occur there is usually no mitigation to correct the problem. Use of road systems by all users, particularly in bad weather or when roads are wet, leads to increased erosion from roads. The increasing use of this country for recreation, and the increasing use of 4-wheel drives and off-highway vehicles, is creating new roads and new sources of erosion. The key questions here are: How do we improve the adequacy of water control features on improved roads? How can erosion sources from two-track roads best be addressed? How can we develop a long term strategy to address erosional issues from these roads? What educational and management tools should be employed to reduce erosion impacts from recreation and other users of public lands?

3. Oil and Gas: Oil and gas field development is increasing in this watershed and across the region. Short and long-term sources of erosion are increasing with this development, but can often be mitigated with good reclamation practices. This is especially true for pipelines and more recently for active and reclaimed natural gas well pads (picture 12-1). However, most other companies are not performing this level quality of pad reclamation to reduce impacts of mineral development on soil erosion. The key question is how to elevate the attention to reclamation by all mineral development companies?

4. Wild Horses: Wild horse populations in both Herd Management Areas (HMA) are currently at the Appropriate Management Level (AML) following gathers in 2001 and 2002. Prior to this, horse populations were two to three times the AML and contributing to impacts upon riparian resources. In a low precipitation desert watershed, with below normal moisture, it is critical for the BLM to keep wild horse populations at the proper level that natural resources can support (picture 12-2). What monitoring must be completed to determine if the current AMLs are the proper population level for each of the two HMAs? Wild horse use becomes concentrated around a small number of reliable water sources in dry years and the horses move out of the HMA into allotments with developed water for livestock. Why isn't adequate funding provided to develop adequate water for wild horses, manage and resolve distribution of use problems, and properly monitor and resolve impacts caused by wild horses? Wild horses occur in the northern half of this watershed area, and in the Boggy Meadows unit west of Highway 287 that is described next.

3) Current Conditions:

Quantifiable data about current erosion levels, ephemeral stream flows, and range condition and trend for the entire area, are not available. Information is available for specific locations from photo-points, upland cover transects, and personal observations.

Stream channels are ephemeral and are moderately vegetated with rhizomatous wheatgrass, basin wildrye, big sagebrush, and other upland species. Most erosion occurs from confined, in-channel sites and from rill and gully erosion from uplands. Much of this is considered background or natural rates of erosion, compared to accelerated rates of erosion caused by impacts from roads or poor grazing practices.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. Research conducted in Wyoming indicated that upland plant communities often

can be maintained with ground cover of 30 percent, while sediment yield increased dramatically when cover declined to less than 30 percent (Linse, Smith and Trlica, 1992). Ground cover ranges from 50 to 75 percent on big sagebrush plant communities and from 40 to 60 percent on saltbush steppe plant communities, the two most common vegetation types in this watershed. Plant cover and litter on one saltbush steppe site south of Wamsutter has improved from 48% to 55% over the past seven years with a rotational grazing system. Greasewood flats and playas are in the 20 to 30 percent range. While this would appear to meet the conditions listed above for accelerated sediment yield, this is not the case, since these sites are on flats and are often the endpoints for water flow off adjacent slopes. The water will pond on these sites with nearly a sealed soil surface due to salts and clays, resulting in most of the water leaving the site as evaporation. This is particularly true for the greasewood flats north of Tipton and adjacent to the Chain Lakes area (picture 13-1). In general, the overall ground cover appears good, but in many locations can still be improved with the use of BMPs.

4) Reference Conditions:

There are no known accounts which describe the watershed conditions for the Great Divide Basin prior to settlement by white men. The lack of water led early explorers to follow the Sweetwater River to the north or the Overland Trail route to the south.

5) Synthesis and Interpretation:

Lack of water in this region also protected it to some degree by the impacts of settlement once the transcontinental railroad was built in 1867. The abundance of saltbush and the ability of sheep to survive on snow, led to winter sheep being the principle use of this country for many years. Too much snow or lack of snow would limit the annual amount of sheep use. Although high levels of utilization probably occurred, the dormant season of use would still have helped maintain the native plant species. For the majority of the area, current species composition and levels of plant cover appear to be in good condition. The gentle terrain with low gradients across many miles also probably helped reduce the impacts that livestock use may have had upon watershed values. In other watersheds, head-cuts and gullies are more pronounced in areas with greater relief and differences in gradient.

The principal changes observed today in this watershed are the roads, gas wells, and fences relating to the existing land uses. Road improvements are probably the most visible recent change seen in this part of the Great Divide Basin. This includes graveling some of the more-frequently used roads used by industry, and using additional culverts and wing-ditching. There is still a large need for further work on nearly all improved roads to reach an adequate level of these types of practices to minimize or eliminate overland flow alterations and erosion caused by roads . This issue is getting larger rather than smaller, with the creation of more roads associated with expanding development of natural gas fields.

The other visible change has been the reclamation efforts around operating wellheads, particularly by BP America, to reduce bare ground that is exposed to wind and water erosion. Other oil and gas companies involved in the same type of work and resource impacts have not reached the same level in their reclamation. Reclamation of pipelines and dry hole locations is generally good.

Management changes relating to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution. These practices have been occurring

over the last 50 years as sheep permits were converted to cattle. Although most allotments now have some type of pasture management system, there are a few allotments without a management system. Areas of historic impact, still observable today, are old sheep bed-grounds along trail routes, adjacent to water sources, and on ridgetops. Plant cover and species composition were negatively affected by the trampling and soil compaction, with site recovery still occurring.

Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. New water developments are used to improve livestock distribution and to create more reliable water sources, in order to get through periods of drought. Oil and gas field development has also contributed significantly to creating new sources of water, which are usually made available for livestock and wildlife use. Control of livestock is also complicated by mineral development activities, which can involve lack of maintenance on cattleguards and leaving gates open.

Horses were brought into North America by the Spanish in the 1500s. Early historical accounts from adjacent watersheds never mention wild horses, but do discuss buffalo, antelope, and other big game species. Most wild horses are the result of domestic horses getting away and becoming wild, or older horses being turned loose. A market for horses developed during World War I and many current-day livestock producers made their start by capturing and selling wild horses. It was a source of extra money to supplement the living made with livestock. The ranches tried to manage wild horses along with their livestock (in a general sense) according to what the land could support. With the advent of the Wild Horse and Burro Act in 1971, responsibility for managing wild horses was given to the BLM. However, adequate funding for roundups, management, and monitoring has been lacking. The current actions being taken has been to protect critical habitats being impacted by wild horses and shift distribution of use patterns by providing additional water sources, both by the BLM and when ranchers pump water for livestock (picture 14-1).

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing condition of primarily ephemeral channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the generally small number of management issues that need to be dealt with, it is determined that the Great Divide Basin watershed is meeting Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole, however, problem areas should identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, which minimize the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using BMPs for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Maintain wild horse populations in the Lost Creek and Stewart Creek HMA's at the current AML for each herd area. Ensure adequate monitoring to determine if this AML is the appropriate level to manage for with regard to watershed values and other multiple uses of public lands. Develop additional water sources and improve distribution of wild horse use away from historic areas of concentrated use due to lack of adequate sources of water.

Expand public education about its role in public land management, particularly regarding impacts from roads and off-highway vehicular activities.

Upper/Lower Separation Creek/Boggy Meadows in the Great Divide Basin

1)Characterization:

This discussion includes three fifth order watersheds: Upper and Lower Separation Creek and Boggy Meadows. They were separated in discussion from the rest of the Great Divide Basin since they each have more defined stream channels, Separation Creek and Lost Soldier Creek, with perennial headwaters derived from Atlantic Rim and Green Mountain, respectively. These watersheds are also similar in terms of originating in 14 to 17 inch precipitation zones and ending in 7 to 9 inch precipitation zones. Soils are predominantly shale and sandy clay-loam soils, with short portions of perennial and intermittent stream segments turning into ephemeral drainages. Rapid snowmelt or thunderstorms can produce moderate to high runoff with medium to high erosion potential. Topography is flat to gently rolling landscape at lower elevations, becoming moderately steep to steep close to rims and headwater locations. The range in elevation is much greater than the rest of the Great Divide Basin, changing 2400 feet in both the Lost Soldier Creek and Separation Creek drainages (picture15-1). This creates high gradient changes near headwater areas, increasing the potential for head-cuts and gullies. The lower two-thirds of both drainages have low gradients with lower potential for gullies. At the terminus of each stream system are intermittent lakes or playas such as Separation Lake, Lost Soldier Lake, and other unnamed locations. In wet years these lakes will last from one season to the next, but they will dry up during years with normal to below normal precipitation.

Due to low topographic relief and infrequent flow events, channel formation is generally weak on smaller drainages and more pronounced on a few larger stream systems. Both types have wide floodplains. However, smaller drainages have channels that range from a few feet across by one to two feet deep to just slight depressions that are hardly recognizable. Main stream channels have very defined channels that are wide and shallow in low gradients, and more confined to even incised where higher gradients occur. Erosion sources include both uplands and in-channel. Peak flows usually occur in February through April when temperatures rise and snow melts across the whole watershed in a short period of time. Flows are erratic and short-term, with no recording of perennial flows. The main channels are mostly fine substrate and only support aquatic life in isolated portions that receive groundwater recharge. The health of the watershed outputs therefore should be evaluated based on the ability to support wetland areas and the water quality in shallow groundwater aquifers.

The only areas where stream flow is perennial and channel classification was determined, were Lost Soldier Creek and Separation Creek, both C6 type streams except for the lower portion of Separation Creek which is an E6 type stream. The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent. Rates of lateral adjustment are influenced by the presence and condition of riparian condition (picture 16-1). The E6 stream type is found where incisement has occurred. Here it is laterally contained in an entrenched valley and evolves to a channel inside a previous channel (Rosgen 1996). This stream type is also a silt-clay dominated, riffle-pool system, with gradients less than two percent creating high meander width ratios, high sinuosities, and low width/depth ratios (picture 16-2). Streambanks are stabilized with riparian vegetation similar to C6 stream types.

Principal human uses in this watershed are oil and gas development, livestock grazing, and recreation. Oil field development has occurred primarily around Bairoil. In addition, there is ongoing coal bed methane drilling just below the headwaters of Separation Creek. Livestock use is primarily cattle, both cow/calf and yearling operations. Sheep use also still occurs on a few allotments. Seasons of use for livestock vary by allotment. Winter use is somewhat dependent on annual climate conditions. Recreation is largely related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

1. Livestock Grazing – (please refer to issues identified for the Great Divide Basin)

2. Erosion- (please refer to issues identified for the Great Divide Basin)

3. Wild Horses- (please refer to issues identified for the Great Divide Basin)

4. Oil and Gas: Oil field development has occurred around Bairoil (and later Ferris) for nearly 80 years (picture 16-3). However, most of this watershed has had only exploratory drilling for oil and gas development with no further activities. Preliminary pod drilling for Coal Bed Methane development is currently underway in the Separation Creek drainage on the west slope of Atlantic Rim. This will likely result in surface discharge of the water being pumped out of the coal seams to release the gas. This water could be used to better manage livestock, however since the water is temporary more permanent water sources may need to be developed to maintain this infrastructure. Continuous flows in systems formed in response to periodic floods from storm events may cause channel adjustments resulting in erosion in the stream channels. Impacts on wildlife from providing temporary water sources need to be assessed for potential changes in migration patterns.

5. Woody Plant Health: The age and canopy cover of big sagebrush, mountain shrub, and aspen woodland plant communities is increasing, leading to lower herbaceous ground cover and water yield. Older shrub and tree communities use more water, have lower infiltration rates and greater surface erosion, all leading to reduced late-season stream flows. Prescribed burns conducted in this and adjacent watersheds have shown improvements in ground cover, reduced surface erosion, and improved late season stream flows. The key question is: How do we as an agency decide on what amounts of treatments should occur to promote higher stream flows and lower soil erosion levels and still address all of the resource values that we are obligated to manage?

3) Current Conditions:

Quantifiable data about current erosion levels, ephemeral stream flows, and range condition and trend for the entire area, are not available. Information is available for specific locations from photo-points, upland cover transects, coal bed development studies, and personal observations.

Perennial and intermittent stream channels that support riparian vegetation are narrowing, with banks becoming more stable with perennial, deep-rooted sedges, rushes, grasses, and in some areas with willows. As the channels narrow, the active floodplain width expands, including within incised banks where the upper slopes continue to widen and become more stable with vegetative cover. In-channel bank sloughing on outer corners and gradient adjustment of ephemeral side drainages are the primary sources of erosion. In a few locations, this includes gully movement through the dams or spillways of old beaver ponds. Hydrologic function is improving due to the above-mentioned changes in stream channels and floodplains. However, the general lack of beaver ponds that were historically present in these system results in faster movement of flow events and reduced water storage for late-season stream flow. The majority of these watersheds have ephemeral stream channels that are moderately vegetated with rhizomatous wheatgrass, basin wildrye, big sagebrush, and other upland species. Erosion occurs from confined, in-channel sites and from rill and gully erosion from uplands. Much of this is considered background or natural rates of erosion, compared to accelerated rates of erosion caused by impacts from roads or poor grazing practices.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. Research conducted in Wyoming indicated that upland plant communities often can be maintained with ground cover above 30%, while sediment yield increased dramatically when cover declined to less than 30% (Linse, Smith and Trlica, 1992). Ground cover ranges from 50% to 85% on big sagebrush plant communities and from 45% to 70% on saltbush steppe plant communities, the two most common vegetation types in this watershed. At upper elevations, plant cover is usually higher, for instance the average cover values in upper Separation Creek drainage were 86%. Trend data shows increases in plant cover and litter, as well as plant densities, which occur primarily as grasses fill in the spaces between shrubs. Plant cover and litter on saltbush steppe sites along Lower Separation Creek has improved from an average of 47% to 61% over the past nine years with a rotational grazing system. One transect established in 1980 south of Lamont showed an increase in cover and litter from 52% to 80% when reread in 1998. Greasewood flats and playas are in the 20% to 30% range. While this would appear to meet the conditions listed above for accelerated sediment yield, this is not the case, since these sites are on flats and are often the endpoints for water flow off adjacent slopes. The water will pond on these sites with nearly a sealed soil surface due to salts and clays, resulting in most of the water leaving the site as evaporation. This is particularly true for the greasewood flats north of Tipton and adjacent to the Chain Lakes area. In general, the overall ground cover appears good, but in many locations can still be improved with the use of BMPs.

4) Reference Conditions:

There are no known accounts which describe the watershed conditions for this portion of the Great Divide Basin prior to settlement by white men. The lack of water led early explorers to follow the Sweetwater River to the north or the Overland Trail route to the south.

5) Synthesis and Interpretation:

Lack of water in this region also protected it to some degree by the impacts of settlement. However, these watersheds were closer to perennial water sources, and therefore, saw earlier and more permanent use and development. They were also along freight lines and travel routes leading away from the railroad, including the Chief Washakie trail north to the Wind River Indian Reservation and the freight road south to Meeker, Colorado and the Ute Indian Reservation. Homesteads sprang up with fenced hay meadows for horses and winter hay. Although sheep were still dominant in these areas, some cattle were run and others drifted in from neighboring ranches (such as the Sweetwater River area) that were solely cattle operations. In the lower and drier locations of the watersheds, the abundance of saltbush still led to winter sheep being the principle use of this country for many years. Too much snow or lack of snow would limit the annual amount of use made by sheep or cattle. Higher levels of forage utilization probably occurred due to both sheep and cattle use (plus wild horses) and being closer to more reliable water sources. Some dormant season of use and seasonal use would still have helped maintain the native plant species. Current species composition and levels of plant cover appear to be in good condition. There are small head-cuts and gullying present on steeper gradients, but current management and plant cover are helping to stabilize these locations. The gentle terrain with low gradients across most of this area has probably helped reduce the impacts that livestock use may have had upon watershed values.

The principal changes observed today in this watershed are the roads and fences relating to the existing land uses. There is still a large need for further work on nearly all improved roads to reach an adequate level of development (primarily additional culverts and wing-ditching) to minimize or eliminate overland flow alterations and erosion caused by roads. This issue is getting larger rather than smaller, with the creation of more roads associated with expanding development of coalbed methane gas fields and recreational users. Evidence of oil and gas development is only apparent around Bairoil, Lamont, Ferris, and the current development for coalbed methane gas. Reclamation of older facilities, as well as pipelines and dry hole locations are generally good.

Management changes relating to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution. These practices have been occurring over the last 50 years as sheep permits were converted to cattle. Areas of historic impact, still observable today, are old sheep bed-grounds along trail routes and adjacent to water sources. Plant cover and species composition were negatively affected by the trampling and soil compaction, with site recovery still occurring. Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. New water developments are used to improve livestock distribution and to create more reliable water sources, in order to get through periods of drought.

The history of wild horses in this area was described for the Great Divide Basin. Watershed impacts attributable to wild horses has usually not been differentiated from livestock. The principle impacts from wild horses in this area are in the Lost Soldier Creek portion of the watershed. The current actions being taken has been to protect critical habitats being impacted by wild horses and shift distribution of use patterns by providing additional water sources, both by the BLM and when ranchers pump water for livestock.

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing condition of primarily ephemeral channels, the management responsibility by industry and agencies to design

and mitigate impacts from roads on hydrologic flow events and soil erosion, and the generally small number of management issues that need to be dealt with, it is determined that the Upper/Lower Separation Creek/Boggy Meadows watersheds are meeting Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole, however, problem areas should be identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, which minimize the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using BMPs for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Maintain wild horse populations in the Stewart Creek HMA at the current AML for the herd area. Ensure adequate monitoring to determine if this AML is the appropriate level to manage for with regard to watershed values and other multiple uses of public lands. Develop additional water sources and improve distribution of wild horse use away from historic areas of concentrated use due to lack of adequate sources of water.

Expand public education about its role in public land management, particularly regarding impacts from roads and off-highway vehicular activities.

Sweetwater River in the North Platte River Basin

1) Characterization:

The portion of the Sweetwater River basin within the report area includes the drainages that originate from the west half of the Ferris Mountains, including Rush, Pete, Cherry, Whiskey, and Muddy Creeks and their tributaries. The lower elevations are in a 10 to 14 inch precipitation zone, while the mountains may reach up to 20 inches of precipitation annually. Soils are generally sandy loams and sandy clay-loams, with gravel and rocks becoming more numerous closer to the mountains and along higher gradient streams. Mountain terrain is steep, with elevation rising 2400 feet in the one mile leading up to the very top (picture 19-1). Slopes get more gentle on the adjacent foothill and plains, with a total elevation change of 3800 feet between the Ferris Mountains and the Sweetwater River.

Cherry Creek and Muddy Creek flow continuously off the mountain, while Pete, Rush and Whiskey Creeks are more intermittent (picture 19-2). Stream flows in the flatter terrain are generally the result of a line of seeps and springs that erupt from geologic faults. Early homesteads were developed in the wider valleys and gentler terrain below these spring and seep locations. Irrigation for hay meadows is reliable here, but is more variable due to climate at lower elevations in the drainages. The majority of the watershed has either a gravel or rocky base

which promotes more lateral stream movement with disturbance, rather than down-cutting. Stream channels are generally stable with rocks and perennial vegetation cover, including willows, waterbirch and other shrubs, and in some locations cottonwood and aspen. There has been no annual flow monitoring for any of the streams in this area. Flows are highest in May and lowest during August or September.

The majority of stream channels in this watershed are C6 and B4 stream types. The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent (picture 20-1). Rates of lateral adjustment are influenced by the presence and condition of riparian condition. Headwater streams on steeper gradients are B4 stream types. This stream type is found in narrow, moderately steep colluvial valleys, with gradients of two to four percent and channel materials composed predominantly of gravel with lesser amounts of boulders, cobble, and sand (picture 20-2). The B4 stream type is considered relatively stable and is not a high sediment supply stream channel (Rosgen 1996). In some areas there may also be B3 stream types with a greater amount of cobble found in the stream channel.

Principal human uses in this watershed are livestock grazing, hay production and recreation. Livestock use is with cattle, employing both cow/calf and yearling operations. Seasons of use are primarily winter and spring at lower elevations and summer and fall at higher elevations. Hay production includes both alfalfa and grass hay, with ground preparation and fertilization in the spring, summer irrigation, putting up hay in during the summer and fall. Recreation is primarily related to hunting, fishing, camping, or using the Continental Divide National Scenic Trail. The highest use period is during the fall hunting season (September through October).

2) Issues and Key Questions:

1. Livestock Grazing: Livestock impacts relate primarily to stream channels, which affect bank stability and width/depth ratios. In some areas there is also a need to address grazing impacts to woody shrubs and aspen vigor and regeneration. The key question is how to expand the use of BMPs from areas that have been successful to the remainder of the watershed?

2. Woody Plant Health: In addition to the discussion about sagebrush, mountain shrubs, and aspen in the Upper Separation Creek section, the Ferris Mountains contain large stands of conifers. Disease and decadence in these communities will lead to large wildfires with potentially severe consequences to watershed values. The use of prescribed burns would lessen these impacts by promoting smaller projects in 'cooler' times of the year. How can the risks of prescribed burning be mitigated and public support raised to implement man-made prescriptions instead of wildfires?

3. Erosion: (please refer to issues identified for the Great Divide Basin)

3) Current Conditions:

Quantifiable data about current erosion levels and stream flows, as well as condition and trend are not available. However, information is available from photo-points, channel cross-sections, and personal observations show that the trend for watershed values is upward. Specific management implemented along with range improvements and vegetative treatments, at least indirectly, should also relate to improved resource conditions in most areas.

The stream channels along Muddy Creek already have a good width-to-depth ratio, while channels along Pete Creek are narrowing, with banks becoming more stable with perennial, deep-rooted vegetation. As the channels narrow, the active floodplain width expands, including both lateral expansion on cobble, gravel, and silt-bottomed streams. In-channel bank sloughing on outer corners and gradient adjustment of ephemeral side drainages are the primary sources of erosion. Rush Creek stream flows tend to be the most intermittent, leading to weaker channel formation. Sedges and rushes provide good bank cover and stability. Whiskey Creek, and to a lesser extent Cherry Creek, exhibit a high amount of bank shear from cattle hooves, reduced bank cover, and wide/shallow stream channels (picture 21-1). This is due to the duration and season of cattle use. Although an Allotment Management Plan has been implemented, further effort is needed to improve channel values. Cherry Creek is starting to show some improvement, but Whiskey Creek is not. Beaver were once present on most of these streams, but are now largely absent.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. Research conducted in Wyoming indicated that upland plant communities often can be maintained with ground cover above 30%, while sediment yield increased dramatically when cover declined to less than 30% (Linse, Smith and Trlica, 1992). Ground cover ranges from 50% to 100% on big sagebrush plant communities, the most common vegetation types in this watershed. At higher elevations, plant cover is usually higher due to increased moisture and density of plants. Trend data shows increases in plant cover and litter, as well as plant densities, which occur primarily as grasses fill in the spaces between shrubs. Plant cover and litter on six pastures monitored in the Bar Eleven allotment has improved from an average of 58% to 82% over the past nine years with a rotational grazing system (picture 21-2). Much of the shallow sandy soils on the north side of the Ferris Mountains is dominated by threadleaf sedge. Although not as productive as the needleandthread grass it grows with, this species and others provide an excellent ground cover that maintains watershed values. In general, the overall ground cover appears good, but in many locations can still be improved with the use of BMPs.

4) Reference Conditions:

John C. Fremont, an army topographer, recorded the earliest documented conditions of the Sweetwater River in 1842. However, he did not actually travel across the watershed written about in this report. The next year marked the start of emigrants moving west across the Oregon Trail following Fremont's route, and the beginning of white men's impacts upon the landscape.

5) Synthesis and Interpretation:

The Sweetwater River received the earliest impacts from white men within the assessment area due to emigrant travel along the Oregon Trail, lasting from the 1840s through the 1870s. This use would most likely be concentrated along the river and not affecting most of the watershed. Tom Sun established the first cattle ranch in the valley in 1872, with other homesteads and settlement occurring thereafter. This area was primarily used with cattle. Small, fenced irrigated meadows provided winter forage, but otherwise the range was open and ranchers worked together to brand, manage, and roundup their livestock. Sheep and horses would also have their influences. In Wentworth's "American Sheep Trails" he describes how sheep were trailed from Oregon and California to Wyoming and other states from the 1880s to the early 1900s. The Sweetwater River drainage was a principle route used to cross Wyoming. A Lander newspaper on August 20, 1882 reported 100,000 sheep on trail along the Sweetwater River. Another reference was about a Dr. Wilson, who in 1898, brought 36,000 sheep across Wyoming at one time to stock the range by selling them to local sheepmen. Horses became more of a factor in the early 1900's as they were

rounded up to sell to the Army as cavalry mounts. Bill Grieve related the fact that all the wild horses were removed from the north side of the Ferris and Seminoe Mountains in the late 1920s, numbering around 3,000 head. The end of the open range and advent of fenced allotments began in the 1940s. The allotments in this area were all single operators and in most cases received better management than under open range conditions.

Vegetation health and ground cover are the primary factors that will reduce fluvial and alluvial erosion in the uplands. Erosion can result in the loss of topsoil and reductions in site productivity in the uplands and horizontal adjustments of stream channels. The primary influences upon these factors that may impact watershed health are current livestock use, wildfire suppression, and roads/off-highway vehicle activities.

Best management practices for livestock grazing that have been implemented in this watershed include: pasture grazing systems to control duration of use, deferment of riparian pastures to late summer or fall use when possible, and development of upland water sources to reduce dependence on streams as water sources. The effects from these changes in management and range improvements are documented with the change in upland cover and litter discussed for the Bar Eleven allotment under current conditions. Changes have also been documented in channel morphology on Pete Creek over the last 15 years. Photo-point and cross-section monitoring has shown tremendous improvement in bank cover and stability, which has led to surface stream width (at base flows) reductions of 50 percent or more in many locations. Changes in stream channel morphology between 1985 and 2002 are shown from one photo-point along Pete Creek (pictures 22-1, 22-2, 22-3). The pictures demonstrate reduced width/depth of the channel, interior bank building and stabilization with perennial riparian vegetation, to the point that willows now screen the stream channel from the photo-point only six feet away. Vegetative bank cover has increased significantly, starting at 25 percent or less and currently exceeding 90 percent. These sites have stabilized with vegetation and, therefore, reduced the unprotected bank area vulnerable to in-channel erosion. The bank building and expansion of riparian habitat (due to narrowing of stream channels), have led to increased late season flows in all perennial streams. These practices are currently being implemented to improve channel conditions along Whiskey and Cherry Creeks.

Fluvial erosional processes dominate this area due to the higher precipitation and higher ground cover. Flood events due to summer rainstorms are the most likely cause of changes in watershed health if vegetation is degraded. Forested systems on the Ferris Mountains are in poor health in some areas and have high fuel loading since there have not been any major fires on the Ferris Mountains since the 1940s (picture 22-4). Promoting forest health in the headwaters by mechanical thinning in diseased stands can be an effective method to improve the sustainability of headwater vegetation. There are many pockets of diseased trees in the Ferris and Seminoe Mountain Ranges, and these areas are less able to withstand and recover from a wildfire. Prescribed fire is needed as a management tool in this area to lower fuel loads and provide a mosaic of vegetation and increased diversity in species and age classes for both woodlands and shrublands.

As roads are upgraded and improved, problems associated with them are generally reduced. Main roads have been graveled or a harder surface developed to reduce long-term maintenance. Simple practices such as wing-ditching have become the standard operating procedure. Water flows are flared out into the vegetation where it benefits plant growth and infiltrates the soil instead of running down the middle or side of the road until it reaches a stream. Greater use of culverts prevents water from running along the road and creating gullies. Improved or closed off stream crossings have reduced vehicular disturbance to channels and banks (pictures 22-5, 22-6).

Off-road vehicle use, particularly four-wheelers, continue to be a problem where people drive them off existing roads and are creating new roads. These are often in an attempt to get higher on the mountain, in steeper terrain, that is more susceptible to erosion once the ground cover is removed.

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing and improving trend in stream vegetation and channel morphology, and the small number of remaining management issues, it is determined that the majority of the Sweetwater River watershed within the report area is meeting Standard #1. The area failing this standard is Whiskey Creek in the Cherry Creek allotment due to livestock management practices. This constitutes about ½ mile of stream channel on public lands. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Continue to implement or manage using BMPs for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Identify and correct any problems with improved and two-track roads, with erosional areas identified and fixed or the road should be closed and reclaimed.

Implement vegetation treatments to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion, and promote reliable, late-season stream flows.

Reintroduce beaver into suitable habitats whenever possible.

Expand public education about its role in public land management, particularly regarding impacts from road and off-highway vehicular activities.

North Platte River Basin other than Sweetwater River

1) Characterization:

The portion of the North Platte River basin within the report area is the west side of Pathfinder and Seminoe Reservoirs. This includes the drainages that originate from the east half of the Ferris Mountains, Arkansas and Sand Creeks, and all of the drainages that start in the Seminoe Mountains, namely Long, Wood, Deweese, Tincup, Sunday Morning, Indian, Hurt, Bothwell and Douglas Creeks. The lower elevations are in a 10 to 14 inch precipitation zone while the mountains may reach 16 to 18 inches of precipitation annually. Soils are generally sands and sandy clay-loams, with gravel and rocks becoming more numerous closer to the mountains and along higher gradient streams. Mountain terrain is moderate to steep, with elevation rising around 1000 feet in the one to 1½ miles separating the edge from the very top. Slopes get more gentle on the adjacent foothill and plains, with a total elevation change of 2500 feet between the Seminoe Mountains and the Pathfinder Reservoir (picture 23.1).

Stream flow is generally intermittent on lower reaches away from the mountains, with flows only reaching the reservoirs during high flow events. Early homesteads were developed in the wider valleys and gentler terrain along the larger streams, such as Sand, Deweese, Wood, Long and Hurt Creeks. Irrigation for hay meadows is reliable here, but is more variable due to climate at lower elevations in the drainages. The majority of the watershed has either a gravel or rocky base which promotes more lateral stream movement with disturbance, rather than down-cutting. Stream channels are generally stable with rocks and perennial vegetation cover, including willows, waterbirch and other shrubs, and in some locations cottonwood and aspen. There has been no annual flow monitoring for any of the streams in this area. Flows are highest in May and lowest during August or September.

The majority of stream channels in this watershed are C6 and B4 stream types. The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent (picture 24-1). Rates of lateral adjustment are influenced by the presence and condition of riparian condition. Headwater streams on steeper gradients are B4 stream types. This stream type is found in narrow, moderately steep colluvial valleys, with gradients of two to four percent and channel materials composed predominantly of gravel with lesser amounts of boulders, cobble, and sand (picture 24-2). The B4 stream type is considered relatively stable and is not a high sediment supply stream channel (Rosgen 1996).

Principal human uses in this watershed are livestock grazing, hay production and recreation. Livestock use is with cattle, employing both cow/calf and yearling operations. Seasons of use are primarily winter and spring at lower elevations and summer and fall at higher elevations. Hay production includes both alfalfa and grass hay, with ground preparation and fertilization in the spring, summer irrigation, putting up hay in during the summer and fall. Recreation is primarily related to hunting, fishing, and camping, and the Seminoe-Alcova Scenic Biway crosses this watershed. The highest use period is during the fall hunting season (September through October).

2) Issues and Key Questions:

Livestock Grazing: (please refer to issues identified for the Sweetwater River)

2. Woody Plant Health: (please refer to issues identified for the Sweetwater River and Upper Separation Creek)

3. Erosion: (please refer to issues identified for the Great Divide Basin)

3. Oil and Gas: The Seminoe Road Coalbed Methane Project is located in this area and will involve the discharge of treated water into ephemeral draws that drain into the North Platte and Seminoe Reservoir (picture 24-3). This water has Total Dissolved Solids concentrations of 600 to 1,200 mg/L and is being treated with aeration to remove iron. The current project is a pilot project, and an Environmental Impact Statement (EIS) is being prepared for the full project build-out. Although scoping has not been completed water disposal methods that may be considered include discharging into ephemeral draws (current practice), piping the water to discharge points in Seminoe reservoir, land applications, different treatment options, and/or injection into a deeper aquifer. Of the disposal methods discharging into ephemeral draws and land applications have the most potential for impacting watershed health. The key question is what method in the long-term picture with large scale development will have the least impact on watershed health? The

disturbance and compaction associated with road and pad construction impacts watershed health by increasing runoff rates and reducing vegetation. Road construction should take place with adequate drainage and culvert systems, but there may be localized problems with drainage crossings. Other water disposal methods and background water quality for this area will be discussed as part of the discussion for Standard 5.

3) Current Conditions:

Quantifiable data about current erosion levels and stream flows, as well as condition and trend are not available. However, information is available from photo-points, channel cross-sections, and personal observations show that the trend for watershed values is upward. Specific management implemented along with range improvements and vegetative treatments, at least indirectly, should also relate to improved resource conditions in most areas.

Stream channels are generally stable, with good vegetative cover and/or rock for armoring, with good width-to-depth ratios. Some channel narrowing will still occur. As the channels narrow, the active floodplain width expands, including both lateral expansion on cobble, gravel, and silt-bottomed streams. In-channel bank sloughing on outer corners and gradient adjustment of ephemeral side drainages are the primary sources of erosion. Sand Creek, however, exhibits a high amount of bank shear from hoof action, reduced bank cover, and wide/shallow stream channels. This is due to the duration and season of cattle use. Although an Allotment Management Plan has been in place for about eight years, further effort is needed to improve channel values. This is in just one pasture out of fifteen, so adjustments in the timing of livestock use should not be a problem. Beaver were once present on most of these streams, but are now largely absent.

There are three locations, on Deweese, Tincup, and Sunday Morning Creek where headcuts presented some management concerns. The causes for all three sites appear to be natural gradient adjustment between the mountains and the reservoir. The site on Deweese Creek was stabilized in the mid-1990s by a fence to exclude livestock and construction of a steel-piling drop structure with rock riprap (picture 25-1). The site on Tincup Creek was stabilized by a gabion basket with rock structure, but washed out shortly thereafter in 1983. It has been moving slowly upstream since that time, primarily due to drier climates and lower flow events. Sunday Morning Creek was stabilized with rock in 2000. Livestock management is not a contributing factor in the movement of these last two headcuts that were described.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. Research conducted in Wyoming indicated that upland plant communities often can be maintained with ground cover above 30%, while sediment yield increased dramatically when cover declined to less than 30% (Linse, Smith and Trlica, 1992). Ground cover ranges from 50% to nearly 100% on big sagebrush plant communities, the most common vegetation types in this watershed. At higher elevations, plant cover is usually higher due to increased moisture and density of plants. Trend data shows increases in plant cover and litter, as well as plant densities, which occur primarily as grasses fill in the spaces between shrubs. Much of the shallow sandy soils on the north side of the Ferris and Seminoe Mountains is dominated by threadleaf sedge. Although not as productive as the needleandthread grass it grows with, this species and others provide an excellent ground cover that maintains watershed values. In general, the overall ground cover appears good, but in many locations can still be improved with the use of BMPs.

4) Reference Conditions:

There are no historic documents in or close to this area that would describe watershed conditions prior to settlement by white men in this area.

5) Synthesis and Interpretation:

The descriptions for the Sweetwater River and Upper Separation Creek sections generally document impacts and conditions through development similar to this watershed . Vegetation health and ground cover are the primary factors that will reduce fluvial and alluvial erosion in the uplands. Erosion can result in the loss of topsoil and reductions in site productivity in the uplands and horizontal adjustments of stream channels. The primary influences upon these factors that may impact watershed health are current livestock use, wildfire suppression, and roads/off-highway vehicle activities.

BMPs for livestock grazing that have been implemented in this watershed include: pasture grazing systems to control duration of use, deferment of riparian pastures to late summer or fall use when possible, and development of upland water sources to reduce dependence on streams as water sources. Changes have also been documented in channel morphology along Sand, Deweese, and Long Creeks over the last 10 years (picture 26-1). Monitoring has shown improvement in bank cover and stability, which has led to surface stream width (at base flows) reductions. Vegetative bank cover has increased significantly, and, therefore, reduced the unprotected bank area vulnerable to in-channel erosion. The bank building and expansion of riparian habitat (due to narrowing of stream channels), have led to increased late season flows in all perennial streams. In most cases there are adequate pastures for rotational grazing, the key is to control the duration and season of use on streams where improvement is still needed.

Fluvial erosional processes dominate this area due to the higher precipitation and higher ground cover. Flood events due to summer rainstorms are the most likely cause of changes in watershed health if vegetation is degraded. Forested systems on the Ferris Mountains are in poor health in some areas and have high fuel loading since there have not been any major fires on the Ferris Mountains since the 1950s. Promoting forest health in the headwaters by mechanical thinning in diseased stands can be an effective method to improve the sustainability of headwater vegetation. There are many pockets of diseased trees in the Ferris and Seminoe Mountain Ranges, and these areas are less able to withstand and recover from a wildfire. Prescribed fire is needed as a management tool in this area to lower fuel loads and provide a mosaic of vegetation and increased diversity of species and age classes for both woodlands and shrublands.

As roads are upgraded and improved, problems associated with them are generally reduced. Main roads have been graveled or a harder surface developed to reduce long-term maintenance. Simple practices such as wing-ditching have become a standard operating procedure on new roads but need to be added to older roads. Water flows are flared out into the vegetation where it benefits plant growth and infiltrates the soil instead of running down the middle or side of the road until it reaches a stream. Greater use of culverts prevents water from running along the road and creating gullies. Improved or closed off stream crossings have reduced vehicular disturbance to channels and banks. Off-road vehicle use, particularly four-wheelers, continue to be a problem where people drive them off existing roads and are creating new roads. These are often in an attempt to get higher on the mountain, in steeper terrain, that is more susceptible to erosion once the ground cover is removed.

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing and improving trend in stream vegetation and channel morphology, and the small number of remaining management issues, it is determined that the majority of the Sweetwater River watershed within the report area is meeting Standard #1. The area failing this standard is Sand Creek in the Buzzard allotment due to livestock management practices. This constitutes about 1½ mile of stream channel on public lands. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Continue to implement or manage using BMPs for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Identify and correct any problems with improved and two-track roads, with erosional areas identified and fixed or the road should be closed and reclaimed.

Implement vegetation treatments to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion, and promote reliable, late-season stream flows.

Reintroduce beaver into suitable habitats whenever possible.

Expand public education about its role in public land management, particularly regarding impacts from road and off-highway vehicular activities.